# Epidemiologic Trends in the Hospitalization of Elderly Medicare Patients for Pneumonia, 1991–1998

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## A B S T R A C T

*Objectives.* This study determined hospitalization rates of elderly Americans for pneumonia from 1991 through 1998.

*Methods.* Epidemiologic data were described for 273 143 pneumonia hospitalizations.

*Results.* Annual hospitalizations for aspiration pneumonia increased by 93.5%. Pneumonia hospitalization rates increased steeply with age, especially among men. Black men were at highest risk for aspiration, unspecified, *Klebsiella,* "other gram-negative," and staphylococcal pneumonia; White men had the highest *Haemophilus* and pneumococcal pneumonia rates. Among women, Blacks predominated in aspiration and *Klebsiella* pneumonia; Whites had the highest *Haemophilus* and bronchopneumonia rates.

*Conclusions.* An epidemic of hospitalization for aspiration pneumonia smoldered over 8 years. Significant disparities existed in hospitalization risks by race, sex, and principal diagnosis. (*Am J Public Health.* 2001;91:1121–1123)

Pneumonia in the elderly is common[1–6] and costly.[7] Medicare claims can be exploited to describe the epidemiology of hospitalization of beneficiaries. The objective of this study was to summarize, using Medicare claims data, the descriptive epidemiology of hospitalization for pneumonia of elderly Americans.

## Methods

A 5% sample of Medicare hospital inpatient bills[8,9] and beneficiary denominator data[10] were processed as described for a contemporaneous study of septicemia.[11] Briefly, the Medicare hospital inpatient bills and denominator data were those of a systematic sample of 5% of the Medicare beneficiaries, who were chosen as having any of a specified list of 5 of the 100 possible permutations of the 8th and 9th digits of the customer account number portion of their unique Medicare health insurance claim numbers. Records of hospitalizations of patients 65 years and older who were discharged from 1991 through 1998 were selected if the principal diagnosis ("the medical condition that is chiefly responsible for the admission of a patient to a hospital . . . determined after the patient has been studied"[12]) matched any of 90 *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)*[13] codes for pneumonia or pneumonitis. A second file selected Diagnosis Related Groups (DRGs) corresponding to a principal diagnosis of pneumonia in adults.[14] Descriptive epidemiologic statistics were determined as described elsewhere.[11]

## Results

The 5% sample yielded 273 143 hospital discharges of elderly patients with a principal diagnosis of pneumonia from 1991 through 1998. "Pneumonia, organism unspecified" encompassed 61% of these pneumonia discharges in 1998. "Pneumonitis . . . due to inhalation of food or vomitus" (aspiration pneumonia) ranked second. In 1998, these 2 diagnoses constituted 77% of the discharges with pneumonia as the principal diagnosis. Eight more codes each represented at least 1% of the discharges. These 10 common diagnoses accounted for 96% of the 1998 total.

Discharges of patients hospitalized for aspiration pneumonia nearly doubled over 8 years (Table 1), whereas elderly Medicare beneficiaries increased by only 11.1%.[11] Increases in discharges for "pneumonia, organism unspecified" also outpaced growth in the population at risk. In contrast, the annual sum of discharges for other pneumonia principal diagnoses peaked in 1995 and then declined.

Annual discharges for DRGs 89 and 90 ("simple pneumonia and pleurisy")[14] fluctuated but generally increased (Table 1). Yearly discharges for DRGs 79 and 80 ("respiratory infections and inflammation"), conferring higher prospective reimbursement to the hospital, increased 60% from 1991 through 1996 before ebbing in 1997 to 1998.

Annual discharge rates for common pneumonia principal diagnoses increased sharply with increasing age of the beneficiaries at risk. Age-adjusted discharge rates[15] for Black or White men invariably exceeded those for women of the same race/ethnicity (Table 2). Age-adjusted discharge rates were significantly[16] higher for Blacks than for Whites of the same sex for the principal diagnoses of aspiration pneumonia and pneumonia ascribed to *Klebsiella pneumoniae.* However, rates for pneumonia due to "organism unspecified," "other gram-negative bacteria," or staphylococci were significantly higher for Blacks only among men.

White women had a higher risk of hospitalization for bronchopneumonia than did Black women (Table 2). White men were at higher risk than Black men for the principal diagnosis of pneumococcal pneumonia (including, under the *ICD-9-CM* rules, "lobar pneumonia, organism unspecified"). Whites

**TABLE 1—Hospitalizations of Elderly Medicare Beneficiaries for Aspiration Pneumonia and for All Pneumonia Principal Diagnoses and Associated Diagnosis Related Groups (DRGs): 5% Sample, 1991–1998 Discharges**

| | Year of Discharge | | | | | | | | Net Change, %, |
|---|---|---|---|---|---|---|---|---|---|
| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1991–1998 |
| Principal diagnosis | | | | | | | | | |
| Pneumonitis due to inhalation of food and/or vomitus | 2974 | 3235 | 3722 | 4022 | 4701 | 5286 | 5736 | 5756 | 93.5 |
| Pneumonia, organism unspecified | 16573 | 16419 | 17765 | 18592 | 19027 | 19038 | 20440 | 22783 | 37.4 |
| All other pneumonia codes | 10745 | 10502 | 11342 | 11359 | 11979 | 11712 | 10821 | 8614 | −19.8 |
| Total of pneumonia codes | 30292 | 30156 | 32829 | 33973 | 35707 | 36036 | 36997 | 37153 | 22.6 |
| DRG | | | | | | | | | |
| Respiratory infections and inflammation | | | | | | | | | |
| With complication and/or comorbidity (DRG 79) | 7033 | 7454 | 8606 | 9300 | 10626 | 11221 | 10903 | 8942 | 27.1 |
| Without complication and/or comorbidity (DRG 80) | 394 | 372 | 401 | 321 | 370 | 341 | 384 | 390 | −1.0 |
| Simple pneumonia and pleurisy | | | | | | | | | |
| With complication and/or comorbidity (DRG 89) | 18575 | 18318 | 19815 | 20354 | 20635 | 20409 | 21591 | 23136 | 24.6 |
| Without complication and/or comorbidity (DRG 90) | 2204 | 1901 | 1823 | 1778 | 1681 | 1729 | 1763 | 2130 | −3.4 |

of both sexes were at higher risk than Blacks for the principal diagnosis of pneumonia due to *Haemophilus influenzae*.

Admission for aspiration pneumonia was associated with the highest case-fatality rate (23.1%) during hospitalization, followed by pneumonia ascribed to staphylococci (20.9%), *Pseudomonas* (15.7%), *K pneumoniae* (14.3%), and "other gram-negative bacteria" (11.1%). Fatal outcomes were least likely with pneumococcal (7.6%) or *H influenzae* (4.3%) pneumonia.

Principal diagnoses of staphylococcal and pseudomonal pneumonia had the highest resource utilization costs,[17] as measured by mean lengths of stay in the hospital (12.4 and 11.9 days, respectively) and in intensive care (1.6 days each). The least specific and most common principal diagnosis—"pneumonia, organism unspecified"—was associated with the briefest mean hospital stay (7.6 days), and only bronchopneumonia engendered a shorter mean duration of intensive care (0.5 vs 0.6 days).

Mean hospital stay for the 10 most common diagnoses was strongly correlated with mean intensive care stay (Pearson $r=0.916$; $P<.001$) and case-fatality rate (Pearson $r=0.802$; $P=.004$).

## Discussion

Not every elderly patient in nonfederal hospitals has Medicare. The likelihood that a patient will be hospitalized varies by type of pneumonia. Selecting pneumonia as the principal diagnosis balances the pulmonary infection against comorbidities such as respiratory failure or cancer. Under managed care capitation,[18] reimbursement to the hospital no longer hinges on the principal diagnosis.

Etiologic diagnosis is difficult in pneumonia.[19] As with the hospitalized veterans studied by Roselle et al.,[20] by far the most common diagnosis was "pneumonia, organism unspecified," which is the least specific rubric for pneumonia. This diagnosis had the briefest mean hospital stay, the second-briefest mean intensive care stay, and a relatively low case-fatality rate and may disproportionately have included patients needing minimal diagnostic testing.

Annual discharges after hospitalization for aspiration pneumonia nearly doubled over 8 years, far outpacing growth in the benefici-

**TABLE 2—Directly Standardized Age-Adjusted Annual Hospital Discharges per 100000 Medicare Beneficiaries Aged 65–89 Years With Most Common Pneumonia Principal Diagnoses, by Race and Sex Pairs: 5% Sample, 1991–1998**

| Principal Diagnosis | Black Men vs Black Women (z) | White Men vs White Women (z) | Black Men vs White Men (z) | Black Women vs White Women (z) |
|---|---|---|---|---|
| Pneumonitis due to inhalation of food or vomitus | 514 vs 241 (22.3**) | 329 vs 159 (58.8**) | 486 vs 290 (20.7**) | 267 vs 171 (16.6**) |
| Pneumonia due to *Klebsiella pneumoniae* | 63 vs 34 (6.6**) | 52 vs 26 (22.6**) | 61 vs 47 (3.7**) | 35 vs 27 (3.9**) |
| Pneumonia, organism unspecified | 1311 vs 884 (20.1**) | 1293 vs 920 (59.3**) | 1259 vs 1186 (3.9**) | 933 vs 960 (2.0) |
| Other gram-negative bacteria[a] | 139 vs 71 (9.1**) | 123 vs 69 (25.7**) | 135 vs 113 (3.2*) | 76 vs 71 (1.2) |
| Pneumonia due to *Staphylococcus*[b] | 110 vs 55 (9.6**) | 97 vs 52 (28.2**) | 103 vs 88 (2.9*) | 59 vs 55 (1.5) |
| Pneumonia due to *Pseudomonas* | 101 vs 46 (10.3**) | 92 vs 51 (25.6**) | 98 vs 86 (2.5) | 48 vs 53 (1.4) |
| Bacterial pneumonia unspecified | 40 vs 24 (4.3**) | 36 vs 25 (10.8**) | 39 vs 34 (1.5) | 25 vs 26 (0.1) |
| Bronchopneumonia, organism unspecified | 60 vs 39 (4.7**) | 68 vs 51 (11.2**) | 57 vs 62 (1.0) | 42 vs 53 (3.7**) |
| Pneumococcal pneumonia[c] | 88 vs 57 (5.6**) | 110 vs 66 (25.3**) | 86 vs 103 (3.1**) | 59 vs 68 (2.3) |
| Pneumonia due to *Haemophilus influenzae* | 40 vs 21 (5.4**) | 70 vs 44 (18.2**) | 40 vs 65 (5.9**) | 22 vs 45 (8.2**) |

*Note.* z = normal deviate for the difference between the paired discharge rates.
[a] *International Classification of Diseases, Ninth Revision, Clinical Modification* code, which excludes *Escherichia coli, H influenzae, K pneumoniae, Pseudomonas* species, and anaerobes, introduced in October 1992. Data are for 1993–1998 discharges.
[b] Includes species-level codes introduced in October 1998.
[c] Includes "lobar pneumonia, organism unspecified."
*$P<.005$; **$P<.001$.

ary population. Meanwhile, expanding managed care and waning precision in recording principal diagnoses could favor progressive underestimation of annual incidence. Aspiration pneumonia falls under DRGs 79 and 80, providing higher reimbursement than do DRGs 89 and 90, which cover the common etiologically vague codes. Hospitals obviously benefit financially from more sensitivity or less specificity in designating aspiration pneumonia rather than generic rubrics, but only "pneumonia, organism unspecified" constituted a reservoir large enough for upcoding to "aspiration pneumonia" to have distorted aspiration pneumonia trends. (Upcoding is the practice of reporting a principal diagnosis that leads to a Diagnosis Related Group (DRG) that confers higher reimbursement than does the DRG related to that principal diagnosis chosen on clinical grounds alone.) However, these 2 diagnoses differed markedly in age-specific hospitalization rates by race/ethnicity, in case-fatality rates, and in mean hospital and intensive care stays. Moreover, discharges for DRGs 79 and 80 declined after 1996 rather than paralleling the continuing increase in aspiration pneumonia.

Older age and male sex are established risk factors for hospitalization for pneumonia.[21,22] The association between race/ethnicity and hospitalization varied by sex and diagnosis. Male sex and Black race were risk factors for cigarette smoking in elderly Americans from 1991 to 1995.[23] The association of hospitalization for pneumococcal pneumonia with White race observed here contrasts with a recent report on invasive pneumococcal infection in Baltimore, Md.[24]

Medicare claims data examined in this report showed unexpected trends and variation in hospitalization of elderly Americans for pneumonia. Of particular concern was the multiyear increase in discharges for aspiration pneumonia, with a very high case-fatality rate and disproportionate occurrence among Black men. This epidemic is not easily dismissed as an artifact of population growth or upcoding. Hypotheses about genetic and environmental risk factors, changes in the occurrence of comorbid conditions, socioeconomic disparities in access to care, and preferences in coding practices remain to be proposed and tested to explain the trends and variation observed. □

## Contributors

W. B. Baine planned the study, analyzed the data, and wrote the paper. W. Yu participated in the statistical analysis, verified the SAS (SAS Institute, Inc, Cary, NC) programs, and reviewed the data analysis. J.P. Summe prepared the specifications for the contractor to edit the original files from the Health Care Financing Administration and participated in the data interpretation and analysis.

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